



COLLEGE *of*  
CHARLESTON

MATH MEET 2024

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## Math Marathon

### Instructions

- The problems are to be worked out individually and independently. Only textbooks and library sources may be used. Calculators and computers may be used. Each entry must be signed by a math teacher within the school to certify that all rules have been followed. Any number of entries from a school may be submitted.
- Work must be shown neatly and concisely. Explain how you got your answer. It is possible that several entries will have correct solutions, so work will be judged on exposition, clarity of thought and ingenuity, as well as correctness. The date of submission will also be considered. Electronic submissions will be accepted only once.
- Include a cover sheet for each entry with the following information: Student Name, Math Marathon, Home Address, E-mail Address, School; Year of Graduation, School Address, Signature of a Math Teacher for Verification.
- All entrants must be students who have not graduated from high school. All entrants must be registered for the Math Meet.
- The judges' decisions will be final.
- All papers are to be submitted electronically to [mathmeet@cofc.edu](mailto:mathmeet@cofc.edu) or mailed to the following address  
Math Meet (Marathon)  
Department of Mathematics  
College of Charleston  
66 George Street  
Charleston, SC 29424
- All entries must be received or postmarked by February 5, 2024.

## Problems

1. What is the length of the longest arithmetic progression of positive integers whose sum is 2102024?

2. A random number generator generates two numbers  $a, b$  uniformly and independently in the interval  $[-\pi, \pi]$ . What is the probability that the function

$$f(x) = \ln(\ln(\ln(a \sin x + b \cos x)))$$

is defined for at least one real value of  $x$ ?

3. A regular  $n$ -gon has area 1 square unit, and every regular  $n$ -gon inscribed in it has area at least 0.99 square units. What is the minimum value of  $n$ ?

4. Find all prime numbers  $p$  for which the sum of the base  $p$  digits of 2024 is 44.

5. Find the largest possible area of a right triangle having integer sides and perimeter 2024 units.